**Quality Assurance Project Plan**

for

# Development of Total Maximum Daily Loads (TMDLs) for the Busseron Creek Watershed in Indiana

**Contract No. 68-C-02-108**
**Task Order No. 2006-20**

Prepared for:

U.S. Environmental Protection Agency Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3507

Prepared by:

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October 29, 2007
Revision 0

This quality assurance project plan (QAPP) has been prepared according to guidance provided in *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5, EPA/240/B-01/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC, March 2001) and *EPA Guidance for Quality Assurance Project Plans for Modeling* (EPA QA/G-5M, EPA/240/R-02/007, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC, December 2002) to ensure that environmental and related data collected, compiled, and/or generated for this project are complete, accurate, and of the type, quantity, and quality required for their intended use. Tetra Tech, Inc., will conduct work in conformance with the quality assurance program described in the quality management plan for Tetra Tech's Fairfax Center and with the procedures detailed in this QAPP.

Approvals:

| | | | |
|---|---|---|---|
| ____________________<br>Kevin Kratt<br>Task Order Leader<br>Tetra Tech, Inc. | ________<br>Date | ____________________<br>Esther Peters, Ph.D.<br>Quality Assurance Officer<br>Tetra Tech, Inc. | ________<br>Date |
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| Robert Tolpa<br>Acting Director, Water Division<br>EPA Region 5 | Date | Kevin M. Pierard<br>Chief, Watersheds and Wetlands Branch<br>EPA Region 5 | Date |

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# Acronyms and Abbreviations

| | |
|---|---|
| AMD | acid mine drainage |
| BMP | best management practice |
| CFR | *Code of Federal Regulations* |
| cfs | cubic feet per second |
| DQO | data quality objective |
| EPA | Environmental Protection Agency |
| FDI | flow duration interval |
| GIS | geographic information system |
| HUC | Hydrologic Unit Code |
| L | liter |
| mg | milligram |
| mL | milliliter |
| MRLC | Multi-Resolution Land Characteristics Consortium |
| NCDC | National Climatic Data Center |
| NHD | National Hydrography Dataset |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | National Resources Conservation Service |
| QA | quality assurance |
| QAPP | quality assurance project plan |
| QC | quality control |
| SSO | sanitary sewer overflow |
| STATSGO | USDA/NRCS State Soil Geographic Database |
| TDS | total dissolved solids |
| TMDL | Total Maximum Daily Load |
| TOL | Task Order Leader |
| TOM | Task Order Manager |
| TSS | total suspended solids |
| WWTP | wastewater treatment plant |
| USGS | U.S. Geological Survey |
| USDA | U.S. Department of Agriculture |

# Distribution

This document will be distributed to the following U.S. Environmental Protection Agency Region 5, Indiana Department of Environmental Management, and Tetra Tech, Inc., staff involved in this project.

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# PROJECT MANAGEMENT

## 1 PROJECT/TASK ORGANIZATION

The purpose of this document is to present the quality assurance project plan (QAPP) for conducting load duration curve analyses to support development of Total Maximum Daily Loads (TMDLs) for the Busseron Creek watershed in Indiana to address waterbody impairments in the study area. The activities supporting TMDL development include watershed characterization, data review and analysis, and load duration analyses.

U.S. Environmental Protection Agency (EPA) Region 5 is funding this project through a task order under EPA's Watersheds contract (no. 68-C-02-108) with Tetra Tech, Inc.; Indiana Department of Environmental Management (IDEM) is providing technical advice and oversight. The Cleveland, Ohio, office of Tetra Tech, which is one of the Tetra Tech Fairfax, Virginia, center offices, will conduct most of the modeling effort.

This QAPP provides a general description of the work to be performed to support the development of TMDLs for Busseron Creek. It addresses the standards to be met and the procedures that will be used to ensure that the TMDL results are scientifically valid and defensible and that uncertainty has been reduced to a known and practical minimum. In addition, this QAPP addresses the use of secondary and third-party data collected by EPA for another purpose or collected by an organization or organizations not under the direction of EPA to support the development of the TMDLs, which includes the following: confirming impairments; defining the location and relative magnitude of potentially contributing sources; defining applicable standards and how modeling efforts should be expressed to be comparable with the standard; performing modeling to identify existing and allowable loads of each pollutant; and identifying known sources of pollutants. Primary data in support of TMDL development was collected in accordance with the sampling and analysis plan (SAP) written by Tetra Tech, under IDEM's existing QAPP. For more details on sampling locations, parameters sampled and frequency of sampling, please refer to the *Busseron Creek TMDL Sampling and Analysis Plan*.

The organizational aspects of the program provide the framework for conducting tasks. They can also facilitate project performance and adherence to quality control (QC) procedures and quality assurance (QA) requirements. Key project roles are filled by the persons responsible for ensuring the collection of valid data and the routine assessment of the data for precision and accuracy, as well as the data users and the persons responsible for approving and accepting final products and deliverables. The program organization chart (Figure 1) shows the relationships and lines of communication among all participants and data users. The responsibilities of these persons are described below.

Robert Tolpa , EPA Region 5 Water Division Acting Director, and Kevin Pierard, EPA Region 5 Watersheds and Wetlands Branch Chief, will provide oversight for this contract. They will review and approve the QAPP and ensure that all contractual issues are addressed as work is performed on this task order.

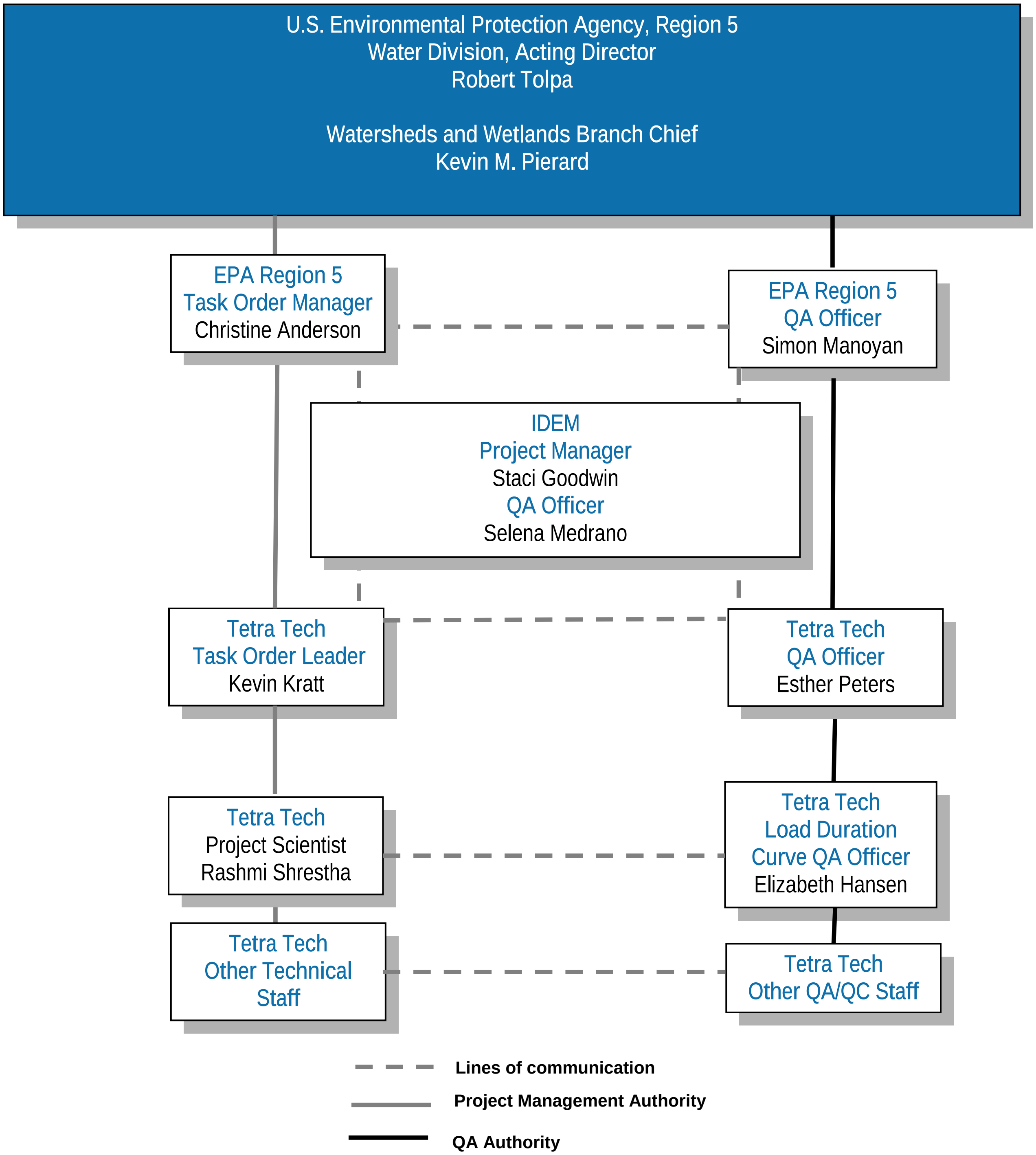


Figure 1. Project organization.

Christine Anderson will provide overall project/program oversight for this study as the EPA Region 5 Task Order Manager (TOM). The EPA Region 5 TOM will work with the Tetra Tech Task Order Leader (TOL) to ensure that project objectives are attained. The EPA Region 5 TOM will also have the following responsibilities:

- Providing oversight for TMDL design, model selection, data selection, and adherence to project objectives

- Coordinating with contractors, reviewers, and others to ensure technical quality and contract adherence

The EPA Region 5 QA Officer, Simon Manoyan, will be responsible for reviewing and approving this QAPP. His responsibilities will also include conducting external performance and system audits and participating in Agency QA reviews of the study.

The Tetra Tech TOL is Kevin Kratt. He will supervise the overall project, including study design and model application. He will provide general oversight and guidance to the rest of the project team. Specific responsibilities of the Tetra Tech TOL include the following:

- Coordinating project assignments, establishing priorities, and scheduling
- Ensuring completion of high-quality projects within established budgets and time schedules
- Acting as primary point of contact for the EPA Region 5 TOM
- Providing guidance, technical advice, and performance evaluations to those assigned to the project
- Implementing corrective actions and providing professional advice to staff
- Preparing and reviewing preparation of project deliverables, including the QAPP, Source Identification Summary, secondary data assessment summary recommendations on revisions to the section 303(d) list, loading capacity report, draft TMDL report, final TMDL report, and other materials developed to support the project
- Providing support to EPA in interacting with the project team, technical reviewers, and others to ensure that technical quality requirements of the study design objectives are met

The Tetra Tech QA Officer is Esther Peters, whose primary responsibilities include the following:

- Providing support to the Tetra Tech TOL in preparing and distributing the QAPP
- Reviewing and approving the QAPP internally
- Monitoring QC activities to determine conformance

Tetra Tech modeling staff will be responsible for developing model input data sets, applying the model, comparing model results to observed data, and writing documentation. They will implement the QA/QC program, complete assigned work on schedule and with strict adherence to the established procedures, and complete required documentation. Other technical staff will perform literature searches; assist in secondary data collection, compilation, and review; and help complete other deliverables to support the development of the draft and final TMDL report by EPA.

The Load Duration QC Officer, Elizabeth Hansen, will provide additional oversight. Ms. Hansen, a member of the modeling staff, is familiar with the model and will not participate in the development of the model under this task order. QC evaluations will include double-checking work as it is completed, and providing written documentation of these reviews to ensure that the standards set forth in the QAPP and in other planning documents are met or exceeded. Other QA/QC staff, including technical reviewers and technical editors selected as needed, will provide peer review oversight of the content of the work products and ensure that they comply with EPA’s specifications.

Because this TMDL project involves a river in Indiana, IDEM will interact with the EPA Region 5 TOM and the Tetra Tech TOL to ensure that the model addresses the study questions and can be implemented by IDEM. The IDEM contacts are Staci Goodwin and Selena Medrano. Users of the model output will include the decision makers, EPA, IDEM, and Tetra Tech.

# 2 PROBLEM DEFINITION/BACKGROUND

Section 303(d)(1)(C) of the Clean Water Act (CWA) and its associated policy and program requirements for water quality planning, management, and implementation (Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require the establishment of a TMDL for the achievement of state water quality standards when a waterbody is water quality-limited. A TMDL identifies the pollutant/waterbody-specific assimilative capacity, which includes an appropriate margin of safety. The focus of the TMDL is reduction of pollutant inputs to a level (or *load*) that fully supports the designated uses of a given waterbody. The mechanisms used to address water quality problems after the TMDL is developed can include a combination of best management practices (BMPs) and/or effluent limits and monitoring required through National Pollutant Discharge Elimination System (NPDES) permits.

The Busseron Creek watershed of the Lower Wabash River Basin is located in southwest Indiana, Hydrologic Unit Code (HUC) 05120111106 (Figure 2). A majority of the land (64.63 percent) is used for agricultural purposes. Row crop accounts for 44 percent of the watershed followed by pasture and grasslands (20 percent). In addition to agriculture, the land is also used for mining purposes with approximately 39 square miles (15 percent) of the land identified as abandoned surface mine sites (concentrated in the eastern part of Sullivan County). Underground mine sites cover approximately 23 percent of the watershed and are in the upper portion of the watershed.

Most of the watershed lies in Sullivan County covering 82.19 percent of the watershed. The remaining portions lie in Clay (3.48 percent), Greene (7.75 percent), and Vigo counties (6.65 percent). Incorporated cities within the watershed include Farmersburg, Shelburn, Sullivan, Hymera, Dugger, Carlisle, and Jasonville.

The original 303(d) listed segments within the Busseron Creek watershed are provided in Table 1. These segments are affected by runoff from a variety of land uses including abandoned and active mine lands, agriculture, forest, rural, and residential.

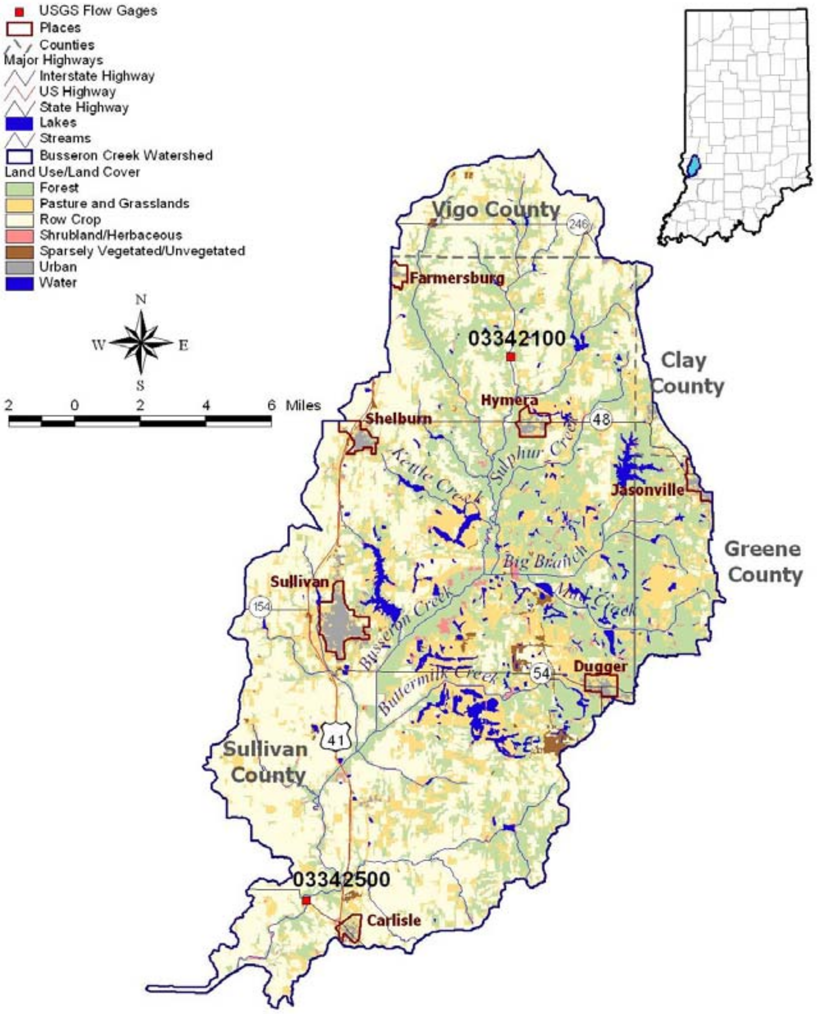


Figure 2. Location and land uses in the Busseron Creek watershed, Indiana.

Table 1. 303(d) listed segments within the Busseron Creek watershed, Indiana (from Tetra Tech's Statement of Work)

| Waterbody | Segment ID | Parameter |
|---|---|---|
| Sulpher Creek | INB11G4_T1024 | copper<br>nickel<br>zinc<br>sulfates<br>pH[a]<br>biotic communities<br>low dissolved oxygen<br>total dissolved solids |
| Big Branch Tributary – Gilmour | INB11G5_T1034 | sulfates<br>total dissolved solids |
| Big Branch - Mud Creek | INB11G6_00 | sulfates<br>total dissolved solids |
| Busseron Creek | INB11G8_T1036 | sulfates<br>total dissolved solids |
| Busseron Creek - Hymera | INB11G7_T1035 | sulfates<br>total dissolved solids |
| Busseron Creek - Paxton | INB11GB_T1037 | sulfates<br>total dissolved solids |
| Busseron Creek - Tanyard Branch | INB11GD_00 | sulfates<br>total dissolved solids |
| Kettle Creek | INB11G_00 | dissolved oxygen |
| Buttermilk Creek | INB11G9_00 | sulfates<br>total dissolved solids |
| Robbins Creek | INB11GA_00 | nutrients |

[a] pH is not pollutant but a measurement. The pH TMDL will be developed using a surrogate pollutant linked to pH impairment.

# 3 PROJECT/TASK DESCRIPTION

Major activities for the development of TMDLs for the Busseron Creek watershed include preparing a Source Identification Summary, collecting and compiling data necessary for the development of the TMDLs, preparing a loading capacity report, and preparing a draft and a final TMDL report. Each activity has inherent QC requirements and requires oversight by an experienced staff person trained in the areas of database management, watershed management, modeling, and TMDL development. The activities can also be divided into a number of tasks, each requiring management and QC oversight by qualified personnel. Task order tasks 10, 11, 13, 14, 15, and 18 from the original Statement of Work are addressed in this QAPP. These tasks have been modified slightly, renumbered, and divided further to support EPA Region 5 in developing TMDLs for the Busseron Creek watershed.

## 3.1 Task 1

Tetra Tech will develop TMDLs for Indiana to address all confirmed impairments in the study area. As part of Task 1, Tetra Tech will work collaboratively with IDEM to finalize the confirmed impairments (the original impairments listed in Table 1 have been modified because of changes in IDEM water quality standards as well as the collection of new data).

## 3.2 Task 2

Tetra Tech will use the results of the sampling collected by IDEM for this project, other existing data, and IDEM approved guidelines and policies to develop TMDLs for the parameters and waterbody segments listed in Task 1. Tetra Tech will prepare a QAPP for the development of TMDLs using secondary data, and in accordance with current EPA guidance.

## 3.3 Task 3

Tetra Tech will finalize its approach for developing TMDLs within 30 days of the approval of the final list of impairments. Tetra Tech's initial approach, outlined below, is based on Tetra Tech's assessment of the available data and applicable tools. Tetra Tech will complete the TMDLs on the impaired segments after 303(d) listing issues are resolved and the impaired segments are identified. Data needed to develop TMDLs are listed in Table 2.

Table 2. Data needed to develop TMDLs for segments of Busseron Creek

| Secondary Data Type | Source[a] | Obtained by Tetra Tech | Application |
|---|---|---|---|
| Land use | MRLC | Yes | Source Assessment, Model Assessment |
| Soils (including soil characteristics) | STATSGO | Yes | Model Application |
| Topography (stream networks, watershed boundaries, contours or digital elevation) | USGS | Yes | Model Application |
| Water quality and biological monitoring station locations | IDEM | Yes | Load Duration Curves |
| Meteorological station locations | EarthInfo Weather Data | Yes | Model Application |
| Permitted facility locations | IDEM | Yes | Source Assessment, Model Application |
| Locations of abandoned mines | IDEM | Yes | Source Assessment, Model Application |
| Impaired water bodies | IDEM | Yes | Impairment Verification, Model Application |
| Historical record (daily) | USGS | Yes | Load Duration Curves |
| Precipitation | EarthInfo Weather Data | Yes | Model Application |
| Temperature | EarthInfo Weather Data | Yes | Model Application |
| Chemical monitoring data | IDEM | Yes | Load Duration Curves |
| Biological monitoring data | IDEM | Yes | Impairment Verification |
| Discharge Monitoring Reports | IDEM | Yes | Source Assessment, Model Application |
| Agricultural practices | USDA, NRCS | Yes | Source Assessment, Model Application |
| Septic Systems | County Health Departments | Yes | Source Assessment, Model Application |
| Mining Activity | IDEM | Yes | Source Assessment, Model Application |

[a]MRLC = Multi-Resolution Land Characteristics Consortium; STATSGO = USDA/NRCS State Soil Geographic Database; USGS = U.S. Geological Survey; NRCS = National Resources Conservation Service; USDA = U.S. Department of Agriculture;

Once the final list of impairments has been established, Tetra Tech will apply load duration curves to identify the existing and allowable loads of each pollutant. Application of load duration curves is a simple process, and it provides accurate information regarding existing and allowable loads with limited resource expenditures. The process for developing load duration curves is explained in more detail below.

Generally, the percentage of time during which specified flows are equaled or exceeded can be compiled in the form of a flow duration curve. This is a cumulative frequency curve of daily mean flows without regard to chronology of occurrence (Leopold 1994). The flow duration curve includes all flows observed at the gauge for the applicable period of record; flow rates are typically sorted from the highest value to the lowest. For each flow value the curve displays the corresponding percentage of time that flow value is met or exceeded—the flow duration interval (FDI), also referred to as the flow recurrence interval.

Extremely high flows are rarely exceeded and have low FDI values; very low flows are often exceeded and have high FDI values.

A load duration limit curve can be created from a flow duration curve by multiplying the flow values by the applicable target and a conversion factor. The independent *x*-axis remains as the FDI, and the dependent *y*-axis depicts the load at that point in the watershed (rather than the flow). The limit curve therefore represents the allowable load (or the TMDL) at each flow condition. Load duration curves can also display observed loads, which are calculated by multiplying the sampled concentration by the instantaneous flow associated with the sample. (The daily mean flow can be used if the instantaneous flow is not available.) Points plotting above the curve represent exceedances of the target and are therefore unallowable loads. Those plotting below the curve represent compliance with the target and are allowable daily loads.

The application of the load duration curve method requires gauged flow and pollutant concentrations. Sufficient flow data are needed to establish return frequencies, and a significant amount of concentration data should be available for comparison to the limit curve. Tetra Tech has checked the U.S. Geological Survey's (USGS) National Water Information System (NWIS) database and determined that both gauges 03342100 and 03342500 have sufficient flow. The flow record from these gauges can therefore be used to approximate flows at the various monitoring sites in the watershed using an area-weighted approach (i.e., flows at the individual monitoring sites are assumed proportionate to flows at the gauge and adjusted to account for drainage area).

Once load duration curves have been applied to determine existing loads, allowable loads, and necessary reductions, Tetra Tech will use a variety of quantitative and qualitative methods to determine the most likely sources. For example, simple mass balance techniques can be combined with the sampling data to estimate the significance of surface and subsurface loads and the most likely sources of concern.

Tetra Tech will provide a description of the existing loads, allowable loads, and necessary reductions in the draft TMDL report.

## 3.4 Task 4a

Tetra Tech will calculate the margin of safety, as well as the load and wasteload reductions resulting from comparing the current impaired baseline scenario to the loads needed to meet water quality standards. Final loads will be presented at IDEM's request and will be defined before the draft TMDL report is prepared.

## 3.5 Task 4b

Tetra Tech will coordinate with IDEM to define details of the project to ensure outputs are applicable to Indiana regulated communities. A conference call will occur before the TMDL development begins to ensure that all parties understand what the TMDL may or may not be able to assess.

## 3.6 Task 5

Tetra Tech will submit the draft TMDL report to EPA no later than October 31, 2007. Modifications to the draft report should be addressed within 10 days of receipt of comments from the TOM. The draft report will comply with the standards listed in Appendix A, *TMDL Decision Document Template*. Five hard copies and one copy in Microsoft Word will be submitted to the TOM.

## 3.7 Task 6

The final TMDL report is due to the EPA no later than December 31, 2007. The final report will meet the standards in Appendix A and will be submitted with all applicable data files, model input files, a working version of any model(s) used, and copies of all references used in developing the TMDL. The report will be submitted to the TOM with five hard copies and one electronic copy in Microsoft Word format. Tetra Tech will respond to any written comments provided by IDEM and EPA Region 5 on the final report within one week of receipt of the written comments.

Table 3 presents the general schedule for the development of deliverables for preparing the TMDLs. Project activities include producing then finalizing the QAPP, developing the TMDLs, and writing draft and final reports.

Table 3. General schedule for Busseron Creek TMDLs technical support deliverables

| **Action/Deliverable** | **Due date** |
|---|---|
| Draft QAPP | Completed January 17, 2007 |
| Source Identification Summary | Draft completed February 28, 2007 |
| Submit Final QAPP for EPA review | September 19, 2007 |
| Define expected modeling inputs and outputs | September 25, 2007 |
| Develop and discuss load duration curves | October 15, 2007 |
| Loading capacity (load duration curves results) | October 15, 2007 |
| Perform GIS integration of land use and known sources of pollutants (creation of GIS database) | October 15, 2007 |
| Draft TMDL Report | October 31, 2007 |
| Final TMDL Report | December 31, 2007 |

# 4 QUALITY OBJECTIVES AND CRITERIA FOR TMDL DEVELOPMENT

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify the intended use of the data, define the types of data needed to support the decision, identify the conditions under which the data should be collected, and specify tolerable limits on the probability of making a decision error due to uncertainty in the data (if applicable). Data users develop DQOs to specify the data quality needed to support specific decisions.

Data of known and documented quality are essential to the success of any water quality study, which in turn generates data to use in evaluations and make decisions. The load duration analysis for the task order under this QAPP will be accomplished using data available from other studies. The QA process for this study consists of using appropriate data, data analysis procedures, modeling methodology and technology, administrative procedures, and auditing. To a large extent, the quality of a TMDL study is determined by the expertise of the project and quality assessment teams.

Project quality objectives and criteria for measurement data will be addressed in the context of the tasks discussed above:

- Define expected modeling inputs and outputs
- Perform watershed characterization and compile, review, and analyze data
- Perform load duration analyses to develop TMDLs for the Busseron Creek watershed
- Perform GIS integration of land use and known sources of pollutants
- Develop TMDL report

## 4.1 Project Quality Objectives

The quality of an environmental analysis program can be evaluated in three steps: (1) establishing scientific assessment quality objectives, (2) evaluating program design for whether the objectives can be met, and (3) establishing assessment and measurement quality objectives that can be used to evaluate the appropriateness of the methods used in the program. The quality of a data set is some measure of the types and amount of error associated with the data.

By establishing and implementing a TMDL, loadings from all sources are estimated, links are established between sources and impacts on water quality, maximum loads are allocated to each source, and appropriate control mechanisms are established or modified so that water quality standards can be achieved (USEPA 1999).

Sections 4.1.1 through 4.1.7 describe DQOs and criteria for TMDL development for this project, written in accordance with the seven steps described in EPA's *Guidance for the Data Quality Objectives Process* (EPA QA/G-4) (USEPA 2000).

### 4.1.1 State the Problem

High levels of pollutants have caused biotic community impairments in segments of the Busseron Creek watershed. The TMDLs to be developed under this QAPP will address discharges of a variety of pollutants (to be identified as part of the study) such as copper, nickel, zinc, sulfates, phosphorus, total suspended solids (TSS), and total dissolved solids (TDS).

### 4.1.2 Identify the Decision

The objectives of this project are to develop TMDLs to address aquatic life impairments in the Busseron Creek watershed.

The allocations will be made at a variety of locations throughout the watershed in accordance with the waterbody impairment. The goal is to provide data to support the identification of key stressors in the watershed and identify pollutant sources and the necessary level of controls to attain water quality standards. Answers to the following study questions will help achieve this objective:

- What are the maximum loads that the Busseron Creek watershed can assimilate and not exceed water quality standards?
- What can be allocated/permitted to an individual point source discharger to ensure that no locations cause or contribute to a violation of a water quality standard?
- Do outputs from the analysis correspond to EPA Region 5's expected outputs on the spatial level of detail, and are they applicable to Indiana's regulated community?

### 4.1.3 Identify the Inputs to the Decision

Inputs to the decision will incorporate information on the designated uses, standards, targets, and details pertaining to causes and sources to be integrated into the TMDL process. To determine the load allocation, Tetra Tech must incorporate available data on flows, water quality, and key pollutant sources.

### 4.1.4 Define the Boundaries of the Study

The tasks in this project must support the goal of quantifying the amount of pollutants causing impairment of aquatic life in the Busseron Creek watershed.

### 4.1.5 Develop a Decision Rule for Information Synthesis

Secondary data will be used to confirm impairments, define the magnitude and extent of impairments, define data gaps, define the location and relative magnitude of potentially contributing sources, evaluate the location of monitoring sites with respect to sources and impaired waterbodies, define applicable standards, and determine existing and allowable pollutant loads. The IDEM contacts will provide much of the data required.

Tetra Tech used a systematic planning process to select the most applicable tool for TMDL development. This process took into account the following elements:

- The ability of the tool to predict a given quantity at the application site of interest to satisfy regulatory objectives. For example, TMDLs must provide estimates of daily loads and therefore the tool had to provide daily output.
- The ability of different tools to accurately and precisely simulate the parameters of concern on the basis of past general experience combined with site-specific knowledge and completeness of the conceptual model.
- How the appropriate criteria would be used to determine whether tool outputs achieve the needed quality.

Acceptance criteria that result from systematic planning address the following types of components for TMDL projects. Criteria used in selecting the appropriate tool, which typically include the following, will be documented for inclusion in the TMDL report:

- Technical criteria (concerning the requirements for the tool's simulation of the physical system)
- Regulatory criteria (concerning constraints imposed by regulations, such as water quality standards)
- User criteria (concerning operational or economical constraints imposed by the end user, such as hardware/software compatibility)

The available tools were compared to enable the Tetra Tech TOL to select the most appropriate one for this study.

The proposed modeling strategy for developing the TMDLs for segments of Busseron Creek watershed is to primarily rely on load duration curves. Other tools or a simple assessment of upstream land uses/land cover might be used solely to provide additional information on key sources (but not to generate estimates of loading capacity).

The load duration curve modeling approach is proposed for the Busseron Creek watershed TMDLs for the following reasons:

- TMDL allocations will be based primarily on the results of the load duration analyses, which in turn, are based on observed flows and water quality observations. The only source of error in estimating the loading capacity is therefore associated with the accuracy of the estimated flows, which is often less than 10 percent. The only source of error in estimating the needed load reductions is associated with the accuracy of the observed samples, which should also be less than 10 percent.

- The load duration curve approach also provides easy insight into the critical conditions.
- The proposed approach to identifying TMDL targets is consistent with other approaches used and approved by EPA and establishes a strong link between the designated use and the TMDL.

*Strengths of the Proposed Approach*

Strengths of the proposed approach include the following:

- The approach is capable of addressing all TMDL requirements and can be completed within the time frame and level-of-effort identified by EPA.
- Explaining the results of a load duration curve to the public can be easier than explaining other technical approaches, such as modeling. This can promote effective communication between TMDL developers and those responsible for implementation.
- The proposed approach is consistent with those applied in neighboring watersheds in Indiana and has been approved by EPA in previous TMDL projects.
- The proposed modeling tools are free and publicly available. This is advantageous for distributing the tools to interested stakeholders and amongst government agencies. It is essentially an *open* framework rather than a black-box modeling system.
- Tetra Tech has significant experience developing TMDLs and developing appropriate modeling or other analytical approaches on the basis of the impairment assessment, data needs and availability, project size, scope, and complexity. Tetra Tech professionals have an in-depth understanding of environmental data and their scientific use for source assessment and model application.

*Potential Weaknesses of the Proposed Approach*

Potential weaknesses of the proposed approach include the following:

- Load duration curves do not provide explicit information on the most significant pollutant sources. An assessment of sources (refer to Section 3.0, Task 3) must be performed using available land use data and information provided by IDEM. It is expected that the source of the pH impairment is from continuous seeps and discharges from historic unreclaimed mining sites.

### 4.1.6 Specify Tolerance Limits on Decision Errors

Quantitative measures, sometimes referred to as calibration criteria, include the relative error between model predictions and observations as defined below:

$$E_{rel} = \frac{\sum | O - P |}{\sum O} \times 100$$

where $O$ = observed value, $P$ = predicted value, and $E_{rel}$ = relative error (percent). The relative error is the ratio of the absolute mean error to the mean of the observations and is expressed as a percentage. A relative error of zero is ideal.

The relative error for the load duration analysis will be evaluated by comparing the predicted flows to the available (limited) observed flows. A target error of less than 10 percent is the proposed tolerance limit.

Note that the tolerance limit will not be the sole arbiter of the usefulness of the load duration analysis. Instead, meeting the tolerance limit will mean that the analysis is proven to perform well enough. However, if the limit is not met, the analysis could still be usable, for instance through an increased margin of safety, but decision makers must be clearly informed about the increased level of uncertainty. In cases where the tolerance limit is not met, Tetra Tech will provide a discussion summarizing the most likely reasons as to why the model did not perform as well as desired.

The estimate of the needed load reductions will be based on a comparison of the observed sampling data to the water quality target. As such, the only error will be that associated with the observed data. Sources of error or uncertainty in statistical inference are commonly grouped into two categories:

- Sampling error: The difference between sample values and in situ true values from unknown biases because of sampling design. Sampling error includes both natural variability (spatial heterogeneity and temporal variability in population abundance and distribution) that is not specifically accounted for in a design (for design-based inference) and variability associated with model parameters or incorrect model specifications (for model-based inference).
- Measurement error: The difference between sample values and in situ true values associated with the measurement process. Measurement error includes bias and imprecision associated with sampling methodology; specification of the sampling unit; sample handling, storage, preservation, and identification; and instrumentation.

These kinds of errors, as well as processing errors, can affect the accuracy and interpretation of results. Not all secondary data evaluated for potential use in the load duration analysis will be judged acceptable for various reasons. The data requirements for this project include aspects of database review and management that will reduce sources of error and uncertainty in the use of the data. The factors to be evaluated to determine whether the data provided in a secondary source are acceptable are described in Section 4.7.

#### 4.1.7 Optimize the Design for Obtaining and Generating Adequate Data or Information

Tetra Tech will use the following general approach to evaluate the quality of secondary data to support the development of TMDLs:

- Maintain a continuing dialog with the EPA Region 5 TOM on technical data issues
- Establish appropriate data quality targets while recognizing the limits of the data
- Document and present the results

Most of the data will be downloaded from high-quality, federal and state data sources. Third-party data might be used for extra support in making decisions for TMDL development, but they will not be used as the only evidence. Information from studies and surveys found to be of unacceptable quality will not be used to support TMDL development. The final TMDL report will include an appendix describing the data used for TMDL development, the period during which the data were collected, and the quality requirements of the data, as appropriate.

The data requirements of this project encompass aspects of both laboratory analytical results obtained as secondary data and database management to reduce sources of errors and uncertainty in the use of the data. For this TMDL project, several types of secondary data are necessary to verify the impairment, make a preliminary source assessment, and apply load duration curves (see Table 2). The types of data commonly required for developing and interpreting load duration curves are listed in Table 4.

Table 4. Types of data commonly required for development and interpretation of load duration curves

| **Data type example measurement** | **Endpoint(s) or units** |
|---|---|
| *Geographic or location information (typically in GIS format)* | |
| Water quality station locations | latitude and longitude, decimal degrees |
| Permitted facility locations | latitude and longitude, decimal degrees |
| Concentrated Animal Feeding Operation locations | latitude and longitude, decimal degrees |
| Impaired waterbodies (georeferenced 2006 303(d)-listed segments) | latitude and longitude, decimal degrees |
| Dam locations | latitude and longitude, decimal degrees |
| CSO locations | latitude and longitude, decimal degrees |
| Mining locations | latitude and longitude, decimal degrees |
| *Flow* | |
| Historical record (daily, hourly, 15-minute interval) | cubic feet per second (cfs); cubic meters per second (cms) |
| Peak flows | cfs or cms |
| *Meteorological data* | |
| Rainfall | Inches or centimeters |
| Temperature | °C |
| *Water quality (surface water, ground water)* | |
| Chemical monitoring data | milligrams per liter (mg/L) |
| Discharge Monitoring Reports | discharge characteristics including flow and chemical composition |
| Permit limits | mg/L |
| *Regulatory or policy information* | |
| Applicable state water quality standards | mg/L |
| EPA water quality standards | mg/L |
| *On-site waste disposal* | |
| Septic systems | number of systems, locations, failure rates |
| Illicit discharges | straight pipes |
| Additional anecdotal information | |
| Stream networks, watershed boundaries, contours or digital elevation, storm water permits, storm characteristics, reservoir characteristics, fish advisories, facility type, permit status, applicable permits, BMPs, major crops, crop rotation, manure management and application practices, livestock population estimates, fertilization application practices, pesticide use, wildlife population estimates, citizen complaints, relevant reports, existing watershed and receiving water models | specific descriptive codes |

Whenever possible, Tetra Tech will download secondary data electronically from various sources—to reduce data entry—and organize it into a standard model application database. In addition, Tetra Tech will develop a GIS database to manage land use, soils, elevation, meteorological, and source-specific loading data to identify known sources of pollutants.

Tetra Tech will use a screening process to scan through the database and flag data that are outside typical ranges for a given parameter. The data used, the period from which the data were collected, and the quality requirements of the data will be included in the TMDL report. If no quality requirements exist or if the quality of the secondary data cannot be determined, a disclaimer that indicates that the quality of the secondary data is unknown will be added. The wording of this disclaimer will be as follows:

> *The quality of the secondary data type compiled for TMDL development could not be determined. Therefore, data were not used in the development of the TMDL allocations.*

Data to be used as input to the effort have been judged to be acceptable for their intended use on the basis of the following acceptance criteria:

- Data reasonableness
  - Tetra Tech has checked the data sets for reasonableness of sample collection dates. As a general rule, no data collected more than 5 years ago will be used to develop the TMDLs.
  - Tetra Tech will consult with IDEM and EPA on any data issues that might arise during final TMDL development.
  - All dates have been checked through queries to ensure that no mistyped dates (e.g., 8/24/2030) and corresponding information are loaded into the models without clarification from the agency from which the data were collected.

- Data completeness
  - Tetra Tech has checked the data sets to determine whether any data are missing. As with all TMDL projects, data gaps exist (e.g., limited information is available for some streams), but these will not preclude development of the TMDL. The data gaps and the assumptions used in filling the gaps will be documented for inclusion in the TMDL report.
  - Anecdotal information on agricultural practices, on-site wastewater, and other sources provided by the general public will be considered in an overall weight-of-evidence analysis but must be complemented by other data/information.

- Data representativeness
  - Tetra Tech has checked the data sets for representativeness of geospatial data. Sampling station data have been checked through queries and mapping to ensure that no mistyped geospatial data (e.g., locations outside Indiana or outside the Busseron Creek watershed) and corresponding information are used during TMDL development.
  - Watershed data (e.g., land use, soils, topography) must be collected by a state or federal agency.
  - Water quality data must be collected by IDEM, USGS, or by a group with an IDEM-approved QAPP.
  - Biological data must be collected by IDEM or U.S. Fish and Wildlife Service.
  - Weather data must be collected by an entity approved by the National Weather Service.
  - Flow data must be collected by USGS or IDEM.
  - NPDES effluent data must be provided by IDEM.
  - Data on agricultural practices, on-site wastewater performance, and such, must be provided by a resource agency specializing in such information (e.g., NRCS, local soil and water conservation districts, health department).

Uncertainty in the data due to sampling and measurement errors or errors introduced during data manipulation could result in identifying a hazard when one does not actually exist or in not identifying a hazard when one does exist. The overall assumption being made during this process is that the results of the assessment should be conservative—errors made by identifying a hazard when one does not actually exist are more acceptable than errors made by not identifying a hazard when one does exist. Reducing data uncertainty is of the highest priority. Because these data will be used to develop control measures—including NPDES permits and actions taken by state, territorial, tribal, or local authorities—to implement TMDLs to reduce pollution, it is important to reduce uncertainty by using the appropriate QC protocols described above.

# 5 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Tetra Tech staff members involved in this project have experience in applying and interpreting load duration curves and developing TMDLs gained through their work on numerous similar projects. The Tetra Tech TOL, who has extensive experience using load duration curves, will provide guidance to the project scientist and will ensure strict adherence to the project protocols.

Kevin Kratt, the Tetra Tech TOL for this project, has been with Tetra Tech for 12 years. He is Tetra Tech's coordinator for TMDL projects in the Midwest and director of Tetra Tech's Cleveland, Ohio, office. Mr. Kratt has been extensively involved in the national and local evaluation of TMDL development activities. He has experience using a holistic approach to watershed management that includes applying knowledge of surface water, ground water, geology, soils, land use, and regulatory requirements.

Elizabeth Hansen, the Load Duration Curve QA Officer, is an environmental scientist with experience in water resources, data analysis, and GIS. She has supported similar watershed analyses and TMDL development efforts for other projects in Indiana and Ohio and is very experienced with the use of load duration curves for TMDL development purposes.

Rashmi Shrestha, a project scientist with Tetra Tech, will be responsible for compiling and organizing the GIS and water quality data for this project and applying the load duration curve tool.

Esther Peters is the QA Officer for this project. She is the QA Manager for Tetra Tech's Fairfax Center offices and has been QA Officer for several contracts, including EPA contracts with the Office of Science and Technology; Office of Wastewater Management; and Office of Wetlands, Oceans, and Watersheds. Dr. Peters has provided technical oversight for projects involving data review, verification, and validation. She has developed QA/QC training programs, prepared contract-specific quality management plans, and reviewed work plans and prepared QAPPs for diverse projects. Dr. Peters is a senior member of the American Society for Quality.

# 6 DOCUMENTATION AND RECORDS

Thorough documentation of all data used to develop and support TMDL development is necessary for the interpretation of study results. Tetra Tech will prepare monthly progress reports that will address task and subtask milestones, deliverables, adherence to schedule, and financial progression at the end of each full month while the task order for this project is open. Other deliverables will be distributed to project participants as indicated by the TOM. Data and assumptions used to develop the TMDL will be recorded and provided to EPA for inclusion in the TMDL report.

EPA Region 5 requires that all information used in TMDL calculations for a specific project be submitted with the final TMDL report. Tetra Tech will develop a complete repository of all the data and information used to develop the TMDLs in a central project file concurrently with TMDL development. The central file will contain copies of all applicable data files, model input files, a working version of the model(s) used, and copies of all references used in developing the TMDLs. Tetra Tech will submit this information with the final TMDL report. A copy of the central file will be maintained at Tetra Tech's Cleveland office for at least 3 years (unless otherwise directed by the EPA Region 5 TOM). The EPA Region 5 TOM and Tetra Tech TOL will maintain files, as appropriate, as repositories for information and data used in models and for the preparation of any reports and documents during the project. Electronic project files will be maintained on network computers and backed up periodically. The Tetra Tech TOL will supervise the use of materials in the central file. If requested by EPA, Tetra Tech will provide this information in an administrative record at a later date.

The hard copy or electronic project files in the central file will include the following information:

- Any reports and documents prepared
- Contract and task order information
- Results of technical reviews, model tests, data quality assessments of output data, and audits
- Documentation of response actions during the project to correct model development or implementation problems
- Assessment reports for acquired data
- Communications (memoranda; internal notes; telephone conversation records; letters; meeting minutes; and all written correspondence among the project team personnel, subcontractors, suppliers, or others)
- Maps, GIS spatial layers, photographs, and drawings
- Studies, reports, documents, and newspaper articles pertaining to the project
- Spreadsheet data files: physical measurements, analytical chemistry data, and microbiological data (hard copy and on diskette)

Copies of formal reports generated from the data and submitted to EPA will be maintained in the central file (diskette and hard copy) at Tetra Tech's Cleveland office. The data reports will include a summary of the types of data collected, sampling dates, and any problems or anomalies observed during sample collection.

# DATA ACQUISITION

## 7 SAMPLING PROCESS DESIGN

Not applicable.

## 8 SAMPLING METHODS

Not applicable.

## 9 SAMPLE HANDLING AND CUSTODY

Not applicable.

## 10 ANALYTICAL METHODS

Not applicable.

## 11 QUALITY CONTROL

The quality of data used to develop TMDLs for this project is addressed, in part, by the training and experience of project staff (Section 5.0) and documentation of project activities (Section 6.0). This QAPP and other supporting materials will be distributed to all personnel involved in TMDL development. The TOL will ensure that all tasks described in the task order for development of the TMDLs are carried out in accordance with this QAPP. Staff performance will be reviewed throughout each of the TMDL development phases to ensure adherence to project protocols.

QC is defined as the process by which QA is implemented in a TMDL project. All project members will conform to the following guidelines:

- All activities that include data interpretation, load calculations, or other related computational activities are subject to audit, peer review, or both. Thus, staff members are instructed to maintain careful written and electronic records.
- A written record of where the data used in the TMDL were obtained will be kept, and any information on data quality will be documented for inclusion in the final report. A written record on where this information is located on a computer or backup media will be maintained in the project files.

The Load Duration QC Officer or her designee will conduct periodic audits of each scientist’s work. Team members will be asked to provide verbal status reports of their work at periodic meetings. Detailed documentation will be made available to members of the modeling workgroup as necessary.

Both project-generated and non-project-generated data will be used for load duration curve development. The QA procedures for project-generated data and database development are discussed elsewhere in this document. All analytical data and most supporting data will have been verified through field QAPP processes before release to the modelers.

The DQOs were discussed in Section 4.0 of this document. The QC Officers will conduct examination of precision, accuracy, representativeness, detectability, and comparability on project-generated data primarily on the basis of best professional judgment and familiarity with similar previous studies. For example, Tetra Tech's TOL and Load Duration Curve QA Officer have developed numerous TMDLs using load duration curves and will therefore be able to identify any potentially spurious results (e.g., unit conversion errors or use of incorrect water quality standard). Project-generated data will be verified and validated using a process that controls measurement uncertainty, evaluates data, and flags or codes data against various criteria. This portion of the QA process is also associated with the final database construction. Modelers will cross-check data for normality, completeness, precision, and accuracy and for bias, outliers, and other potential problems.

Non-project-generated data might be obtained from published or unpublished sources. The published data will have some degree or form of peer review. Typically, modelers examine these data as part of a data quality assessment. Databases that have not been published are also examined in light of a data quality assessment. Data provided by IDEM or other sources will be confirmed to have met precision objectives established by those entities.

Non-modeling data (e.g., watershed characterization and data assessment) will be checked through technical reviews performed by the TOL.

# 12 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Most of the work conducted by Tetra Tech for TMDL development will involve acquiring and processing data and generating reports and documents, both of which require maintaining computer resources. Tetra Tech's computers are covered by on-site service agreements or serviced by in-house specialists. When a problem with a microcomputer occurs, in-house computer specialists diagnose the trouble and correct it if possible. When outside assistance is necessary, the computer specialists call the appropriate vendor. For other computer equipment requiring outside repair services and not currently covered by a service contract, local computer service companies are used on a time-and-materials basis. In-house computer specialists perform routine maintenance on microcomputers. Electric power to each microcomputer flows through a surge suppressor to protect electronic components from potentially damaging voltage spikes. All computer users have been instructed on the importance of routinely archiving task order data files from hard drive to compact disc or floppy disk storage. The Cleveland office network server is backed up approximately monthly. Screening for viruses on electronic files loaded on microcomputers or the network is standard company policy. Automated screening systems have been placed on Tetra Tech's computer systems and are updated regularly to ensure that viruses are identified and destroyed promptly.

# 13 MODEL CALIBRATION AND FREQUENCY

Not applicable.

# 14 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Not applicable.

# 15 NON-DIRECT MEASUREMENTS

Non-direct measurements (also referred to as non-project-generated data) are data that were previously collected under a different effort outside this task order. Most impaired waterbodies have been listed for TMDL actions on the basis of historical water quality monitoring programs. In many cases, there is a very comprehensive and complete historical database that can be used for load duration curve development without the need for collecting new data. Non-direct data can come from a number of sources, but the non-direct data most often used in TMDL modeling projects are typically obtained from the USGS stream gauge database, EPA’s Storage and Retrieval System (STORET), EPA’s Permit Compliance System, and databases maintained by state agencies. These data have been discussed in Table 2 and Section 4.7.

Non-project-generated data may be obtained from published or unpublished sources. The published data have some form of peer review. These data are generally examined by modelers as part of a data quality assessment. Databases that have not been published are also examined in light of a data quality assessment. Tetra Tech will assume that data provided by EPA, IDEM, or other sources meets precision objectives established by those entities. If historical data are used, a written record of where the data were obtained and any information on their quality will be documented for inclusion in the final report (see Section 11.0.).

# 16 DATA MANAGEMENT

The Load Duration QC Officer will review or oversee review of all data related to the project for completeness and correctness. The Load Duration QC Officer will identify any issues of concern to the Tetra Tech TOL, who will resolve these issues with the team.

Raw data received in hard copy format will be entered into the standard database. Team personnel will compare all entries to the original hard copy data sheets. Screening methods will be used to scan through the database and flag data that are outside typical ranges for a given parameter. Data will also be manipulated using specialized programs and Microsoft Excel 2000. Ten percent of the calculations will be recalculated by hand to ensure that correct formula commands were entered into the program. If 5 percent of the data calculations are incorrect, all calculations will be rechecked after the correction is made to the database. Data quality will be assessed by comparing entered data to original data; performing the data and model evaluations described in Sections 4.0, 13.0, and 17.0; and comparing results with the measurement performance or acceptance criteria summarized in the Source Identification Summary document to determine whether to accept, reject, or qualify the data. Results of the review and validation processes will be reported to the EPA Region 5 TOM.

# ASSESSMENT/OVERSIGHT

## 17 ASSESSMENT AND RESPONSE ACTIONS

The Tetra Tech TOL will conduct technical reviews of non-modeling data (e.g., watershed characterization and data assessment). The TOL will notify the QC Officer of any issues and will make sure the appropriate corrective actions are taken.

As described in Section 15.0, Tetra Tech will use non-project-generated data for development of load duration curves. The QC Officer will conduct rigorous examination of precision, accuracy, representativeness, detectability, and comparability on project-generated data. These data will be verified and validated using a process that controls measurement uncertainty, evaluates data, and flags or codes data against various criteria. This portion of the QA process is also associated with the final database construction. Modelers will cross-check data for normality, precision, accuracy, bias, outliers, and other potential problems.

Data generated outside the project may be obtained from published or unpublished sources. The published data will have some degree or form of peer review. Typically, modelers examine these data as part of a data quality assessment. Unpublished databases are also examined in light of a data quality assessment. Tetra Tech will assume that data provided by IDEM or other sources meet precision objectives established by those entities.

The QA program under which this task order will operate includes surveillance, with independent checks of the data obtained from sampling, analysis, and data gathering activities.

The essential steps in the QA program are as follows:

- Identify and define the problem.
- Assign responsibility for investigating the problem.
- Investigate and determine the cause of the problem.
- Assign and accept responsibility for implementing appropriate corrective action.
- Establish the effectiveness of and implement the corrective action.
- Verify that the corrective action has eliminated the problem.

If quality problems that require attention are identified, Tetra Tech will determine whether attaining acceptable quality requires short- or long-term actions. If a failure in an analytical system occurs (e.g., performance requirements are not met), the QC Officers will be responsible for corrective action and will immediately inform the Tetra Tech TOL or the QA Officer, as appropriate. Subsequent steps taken will depend on the nature and significance of the problem.

The Tetra Tech TOL has primary responsibility for monitoring the activities of this project and identifying or confirming any quality problems. These problems will also be brought to the attention of the Tetra Tech QA Officer, who will initiate the corrective action system described above, document the nature of the problem (using a form such as that shown in Figure 3), and ensure that the recommended corrective action is carried out. Many of the possible technical problems can be solved on the spot by staff, for example, by correcting errors or deficiencies in documentation. Immediate corrective actions are standard operating procedures, and they are noted in records for the project. Problems that cannot be solved in this way require more formalized, long-term corrective action.

**CORRECTIVE ACTION REQUEST AND RESPONSE VERIFICATION**

**Contract (name)** ___________________________

Date of Assessment _________________ Request No. ________________

Title (of project or other) _________________________________________________

Project Leader ____________________________________ TC# ______________________

Other Responsible Personnel ________________________________________________

Auditor or Initiator of This Corrective Action Request ________________________________

**Problem Description:**

**Recommended Action:** **Date to Be Completed:**

________________________________ ________________________
Quality Assurance Officer Date

________________________________ ________________________
Principal-in-Charge or Program Manager Date

**Action Taken:** **Date:**

**Verification of Completion of Corrective Action:**

________________________________ ________________________
Quality Assurance Officer Date

________________________________ ________________________
Principal-in-Charge or Program Manager Date

*Original form to be filed in QAO File; one copy to be filed in Project File and one copy in Contract File (if corrective action pertains to a project), or one copy to be filed in Contract File (if corrective action pertains to a contract).*

Figure 3. Example Corrective Action Request and Response Verification Form.

The EPA Region 5 TOM and Tetra Tech TOL will be notified of major corrective actions and stop work orders. Corrective actions may include the following:

- Reemphasizing to staff the project objectives, the limitations in scope, the need to adhere to the agreed-upon schedule and procedures, and the need to document QC and QA activities
- Securing additional commitment of staff time to devote to the project
- Retaining outside consultants to review problems in specialized technical areas
- Changing procedures

The Tetra Tech TOL may replace a staff member, as appropriate, if it is in the best interest of the project to do so.

Performance audits are quantitative checks on different segments of project activities; they are most appropriate for sampling, analysis, and data-processing activities. The QC Officers are responsible for overseeing work as it is performed and periodically conducting internal assessments during the data entry and analysis phases of the project. As data entries, model codes, calculations, or other activities are checked, the appropriate QC Officer will sign and date a hard copy of the material or complete Tetra Tech's standard Technical/Editorial Review Form, as appropriate, and will provide this to the Tetra Tech TOL for inclusion in the central project file. Performance audits will consist of comparisons of model results with observed historical data. Performing control calculations and post-simulation validation of predictions is a major component of the QA framework.

Internal peer reviews will be documented in the project and QAPP files. Documentation will include the names, titles, and positions of the peer reviewers; their report findings; and the project management's documented responses to their findings.

The Tetra Tech TOL will perform surveillance activities throughout the duration of the project to ensure that management and technical aspects are being properly implemented according to the schedule and quality requirements specified in this QAPP. These surveillance activities will include assessing how project milestones are achieved and documented, corrective actions implemented, budgets adhered to, peer reviews performed, and data managed, and whether computers, software, and data are acquired in a timely manner.

System audits are qualitative reviews of project activity to check that the overall quality program is functioning, and that the appropriate QC measures identified in the QAPP are being implemented.

# 18 REPORTS TO MANAGEMENT

Tetra Tech will prepare and submit a Source Identification Summary to the EPA Region 5 TOM for review and approval at the initial stages of the TMDL development. Throughout the TMDL development process, the Tetra Tech TOL will submit technical memoranda, as needed, to the EPA Region 5 TOM for review and approval before further steps are taken. The memoranda will describe each major step taken to support TMDL development for this project. Such steps might include use of existing data; a plan for assessing data quality; and the proposed approach for model application, calibration, and validation.

Once a month, the Tetra Tech TOL will provide the EPA Region 5 TOM with a report describing the status of the project and the results of any intermediate assessments. The results of the TMDL study will be provided to the EPA Region 5 TOM in the TMDL report summarizing the results of this study after all analyses have been completed. The draft and final TMDL reports will include a separate section titled *Data Quality* to relate the results of the study back to this QAPP and the Source Identification Summary document. The section will contain, at a minimum, (1) where all the data were obtained, (2) the reason the data were originally collected, and (3) all readily available information related to QA associated with the data collection and handling. The section will also present a brief summary of the QA procedures used when the data were processed.

# DATA VALIDATION AND USABILITY

## 19 DATA REVIEW, VERIFICATION, AND VALIDATION

Data review and validation services provide a method for determining the usability and limitations of data and provide a standardized data quality assessment. The project staff, including Rashmi Shrestha, Elizabeth Hansen, and Yoichi Matsuzuru, are experienced professionals and will perform the data review, compilation, and evaluation phases of the study. Tetra Tech will be responsible for reviewing data entries, transmittals, and analyses for completeness and adherence to QA requirements. The data will be organized in a standard database on a microcomputer. A screening process that scans through the database and flags data that are outside typical ranges for a given parameter will be used. Values outside typical ranges will not be used to develop model calibration data sets or model kinetic parameters.

## 20 VERIFICATION AND VALIDATION METHODS

Not applicable.

## 21 RECONCILIATION WITH USER REQUIREMENTS

Tetra Tech will calculate all data quality indicators at the completion of the data analysis phase. Measurement quality requirements will be met and compared with the DQOs to confirm that the correct type, quality, and quantity of data are being used for this TMDL project. The interpretation and presentation stage includes inspection of the form of the results, as well as the meaning and reasonableness of the computation results and post-simulation analysis.

Project staff will review the results of the load duration analyses for reasonableness, relevance, and consistency with the requirements of the TMDL development process. Staff will also determine consistency with the acceptance criteria described in Section 4.0 of this QAPP. The TOL will ensure that all steps of the project are performed correctly. Electronic copies of the input and output data, and QA reports will be part of the central file for the TMDL report.

Any major problems found during the assessment of output will be reported to the Tetra Tech TOL, and any corrective actions will be discussed with the EPA Region 5 TOM as described in Section 17.0 of this QAPP.

# Literature Cited

Leopold, Luna. 1994. *A View of the River*. Harvard University Press, Cambridge, MA.

USEPA (U.S. Environmental Protection Agency). 1999. *Draft Guidance for Water Quality-based Decisions: The TMDL Process*, 2nd ed. EPA 841-D-99-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2000. *Guidance for the Data Quality Objectives Process* (G-4). EPA 600-R-96-055. U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC.

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# APPENDIX A

Total Maximum Daily Load (TMDL) Decision Document Template

EPA provided the following template to be used for this task order as Attachment 2 of the *Task Order 2006-18 Statement of Work for Development of Total Maximum Daily Loads (TMDLs) for Busseron Creek watershed TMDL development*:

## TMDL TEMPLATE REQUIREMENTS

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb *"must"* below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "*should*" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves.

### 1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the waterbody as it appears on the State's/Tribe's 303(d) list. The waterbody should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard (see section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the waterbody. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired waterbody is located;

(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);

(3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;

(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and

(5) an explanation and analytical basis for expressing the TMDL through *surrogate*

*measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

## 2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. (40 C.F.R. §130.7(c)(1)).
EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

## 3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f) ).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for stream flow, loading, and water quality parameters as part of the analysis of loading capacity [40 CFR 130.7(c)(1)]. TMDLs should define applicable critical conditions and describe their approach to estimating both point and nonpoint source loadings under such critical conditions. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings (e.g., meteorological conditions and land use distribution).

## 4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g) ). Where possible, load allocations should be described separately for natural background and nonpoint sources.

## 5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i) ). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permitees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

## 6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1) ). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e., expressed in the TMDL as loadings set aside for the MOS). If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

## 7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1) ).

## 8. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a NPDES permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

## 9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

## 10. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

## 11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii) ). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2) ).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

## 12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a *technical review* or *final review and approval*. Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the waterbody, and the pollutant(s) of concern.